DESCRIPTION OF CIRCUIT REQUIREMENT TABLES

1. GENERAL

1.01 This section describes the circuit requirement tables furnished with circuit drawings.

1.02 This section is reissued to revise the description of the general form of circuit requirement tables to include changes resulting from the introduction of the detached-contact type of circuit drawing; to revise figures illustrating the tables to show changes in headings, and to add references to AF-, AG-, and AJ-type wire-spring relays in Table A. Detailed reasons for reissue will be found at the end of this section. Since this reissue covers a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.03 The term circuit requirement table (CRT) includes tables of mechanical and current flow requirements and timing requirements. These tables are headed CIRCUIT REQUIREMENTS or TIMING REQUIREMENTS.

1.04 The illustrations of circuit requirement tables in this section show typical tables and are not to be considered as representing any particular circuit.

1.05 With the introduction of "detached-contact type" circuit drawings, the circuit requirement and timing requirement table forms standardized in 1947 for use with "attached-contact type" circuit drawings were modified and the modified forms were standardized for use with the "detached-contact type" circuit drawings. Several of these modifications were also incorporated in the forms which were continued for "attached-contact type" circuit drawings. Fig. 34 shows the CRT form standardized in 1947 and Fig. 35 shows the headings of the modified form standardized for "detached-contact type" circuit drawings. Fig. 36 shows the TRT form standardized in 1947 and Fig. 37 shows the headings of the later modified form.

1.06 This section covers both the present standard circuit requirement tables and those that were previously standard. An explanation of the information covered on these tables is found in the following parts of this section.

PART 2 - GENERAL FORM OF TABLES

PART 3 - CIRCUIT REQUIREMENT TABLE STANDARDIZED IN 1947 and SUBSEQUENT MODIFICATIONS

PART 4 - CIRCUIT REQUIREMENT TABLES STANDARD FROM 1925 TO 1947

PART 5 - CIRCUIT REQUIREMENT TABLES STANDARD PRIOR TO 1925

1.07 The following index lists the column headings and the numbers of the paragraphs describing them as used in the various types of circuit requirement tables.

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Index of Circuit Requirement Table Column Headings

Column Heading	Paragraph Describing Column Headings		
	Tables 1947 to Date (Figs. 34 to 37)	Tables 1925 to 1947 (Figs. 28 to 31)	Tables Before 1925 (Figs. 32 and 33)
ADJ POT.	3.70	-	-
AFTER SOAK	3.49-3.50	4.18	4.18
APPARATUS	3.06-3.14,3.61	4.03-4.05	5.05
ARM. TRVL	3.20	4.09	5.12
BLOCK	-	-	5.13
BLOCK OR INSULATE	3.22-3.24,3.62	4.13	-
BSP FIG.	3.15-3.18	4.07	-
CIRCUIT PREPARATION	3.21-3.26,3.62,3.63	4.13	5.13
CKT FIG.	3.09	-	-
CODE	3.07	3.07	5.08,5.16
COIL NO.	-	-	5.17
CONN. BAT.	3.25	3.25	3.25
CONN. BK, R, W	3.63	-	-
CONN. GRD.	3.25	3.25	3.25
CONT PRESS.	3.19	4.08	5.11
DESIG	3.06,3.61	4.03-4.05	5.09,5.18
DIRECT CURRENT FLOW REQ	3.45-3.51	4.16-4.18	5.20,5.21
FEATURE OR OPTION	3.08	-	-
FIG.	3.09	-	-
FIG. OR SK	-	-	3.14-3.17
FOR MIL SEC.	3.71	-	-
LOC	3.11,3.12	4.11,4.12	-
MECH REQ	3.15-3.18	4.06-4.10	5.10-5.12
OPTION	3.08	3.08	-
OPTIONS	-	4.20	-
PARALLEL COMBINATION	3.51(k)	3.51(k)	-
POLAR RELAYS	3.26	-	-
RATING	3.10	-	-
READJ MA.	3.51	4.18	4.18
REC SW	3.65	-	-
RELAYS	-	-	5.07-5.09,5.15-5.19
REMARKS	3.52,3.53,3.69	4.21	3.53,3.54
RESID	3.11,3.13	4.11,4.12	3.11,3.13
SEE NOTE	3.44	-	-
SEE TEST NOTE 1	-	-	5.03
SEE TEST NOTE NO.	3.44,3.66	4.15	-
SEND KEY	3.64	-	-
SEQ SW POS	3.14	3.14	3.14
SPEC NO.	-	-	5.10
SPRING ASSEMBLY AND ADJUSTMENT	-	4.10	4.10
STYLE OF CORE	-	-	5.19
TEST MA.	3.51	4.18	4.18
TEST CLIP DATA	3.25,3.26,3.63	3.25,3.26	3.25,3.26
TEST FOR	3.48,3.67	4.18	4.18
TEST SET PREP.	3.27-3.43,3.64,3.65	4.14	4.14
TEST WDG	3.46,3.47	4.17	5.20
TIME REQ	3.52,3.54,3.68-3.81	4.19	-
TIMING REQ TABLE	3.57-3.71	-	-
ELECTRON TUBES	3.55,3.56	3.56,3.55	-
TRANSMISSION REQ	-	-	5.04
WDG RES	-	-	5.21

2. GENERAL FORM OF TABLES

2.01 Size of Pages: The present standard circuit requirement tables (CRTs) are a part of the SD drawings. Where all the information in a CRT cannot be placed on a single CRT form, additional forms are used and may be printed on the same sheet of the SD drawing. Each of these forms is given a page number and may be cut out from the sheet of the SD drawing to be used as a separate page of the CRT. Each page is the standard letter size of 8-1/2 by 11 inches. Certain CRTs are furnished in reduced size, 5-1/8 by 6-7/8 inches.

2.02 Page Numbering of CRTs: If the circuit requirements cannot be put on one page, additional pages are used. On all CRTs, the page number appears near the bottom of the drawing issue column. On the attached-contact type of circuit drawing, having more than one page, the number of pages appears on the first page in the top line at the left between the circuit number and heading. On the detached-contact type of circuit drawing and also on some attached-contact types, the number of pages appears in parentheses in the drawing issue column below the page number on all pages.

Note: For explanation of the attached-contact and detached-contact type of circuit drawing, refer to Section 005-109-101.

2.03 Title of Table: The first page of each CRT shows the abbreviated circuit title and/or equipment designation on a line directly below the heading CIRCUIT REQUIREMENTS. The CRT title contains the essential points covered in the title of the drawing of which it is a part. The equipment designations correspond to the equipment designations in the title box of the associated circuit drawing and are provided to facilitate locating the apparatus on the frame.

2.04 Issue Number of CRT: On drawings not issued on an individual sheet basis, the issue number of the CRT always corresponds with the issue number of the circuit drawing and is shown in the extreme right-hand column of all pages of the table. On drawings issued on an individual sheet basis, only those sheets of the circuit drawing that are actually affected by changes are reissued and therefore, the issue number of the CRT may not correspond with the issue number of the circuit drawing. On drawings issued in an individual sheet basis, the sheet index, which shows the contents of each sheet of the drawing, may be referred to for the latest issue number of the CRT.

2.05 Test Notes: In general, all test notes referred to on a page of the CRT are given on that page and are located immediately below the apparatus requirement space. The test notes are numbered from 1 up on each page.

Note: On some of the earlier CRTs, the test notes for all of the pages are shown only on the last page of the table.

3. CIRCUIT REQUIREMENT TABLE STANDARDIZED IN 1947 AND SUBSEQUENT MODIFICATIONS

3.01 Types of CRT: Two types of CRT are standard at the present time, namely:

Tables Headed	Shown in Figures	Described In
CIRCUIT REQUIREMENTS	34 & 35	3.02-3.56
TIMING REQUIREMENTS	36 & 37	3.57-3.81

TABLES HEADED - CIRCUIT REQUIREMENTS

3.02 Contents of Table: Tables headed CIRCUIT REQUIREMENTS cover the electrical and mechanical requirements applicable to relays and other apparatus. In some cases they may also contain timing requirements. When these requirements are applied, together with other apparatus requirements in the BSP, the apparatus in the circuit should function properly.

3.03 Information covering pulsing, timing, electron tube requirements, and charts covering pulsing requirements is shown after the apparatus listings on the CRT.

3.04 Division of Table: Fig. 1 - The table is divided into main divisions which are further subdivided as follows:

Column Heading		Described In
APPARATUS		3.05-3.10
DESIG		3.06
CODE		3.07
OPTION	See note 1	3.08
CKT FIG.	See note 2	3.09
RATING	See note 3	3.10
LOC	See note 4	3.11,3.12
RESID	See note 4	3.13
SEQ SW POS	See note 4	3.14
MECH REQ		3.15-3.20
BSP FIG.		3.15-3.18
CONT PRESS.		3.19
ARM. TRVL		3.20

Column Heading	Described in
CIRCUIT PREPARATION	3.21-3.26
BLOCK OR INSULATE	3.22-3.24
TEST CLIP DATA	3.25,3.26
CONN. BAT.	3.25
CONN. GRD	3.25
TEST SET PREP	3.27-3.43
SEE TEST NOTE NO. See note 5	3.44
DIRECT CURRENT FLOW REQ	3.45-3.52
TEST WDG	3.46,3.47
TEST FOR	3.48
AFTER SOAK	3.49,3.50
TEST (MA.)	3.51
READJ (MA.)	3.51
REMARKS	3.52-3.54
TIME REQ	3.52-3.54

Note 1: Designated FEATURE OR OPTION on attached-contact type circuit drawings prior to 1951.

Note 2: Designated FIG. on detached-contact type circuit drawings.

Note 3: Column omitted on detached-contact type; deleted from attached-contact type in 1953.

Note 4: Used only on certain drawings of either type.

Note 5: Designated SEE NOTE on detached-contact circuit drawings.

3.05 The meaning of each of the column headings given above is covered in detail in the following paragraphs.

APPARATUS

DESIG

3.06 In this column are given the functional designations which are assigned to the various pieces of apparatus in the circuit. The apparatus is divided into groups which appear in the following order:

Magnets (such as crossbar magnets and rotary selector magnets)

Relays (including relays, signals, drops, and message registers)

Electron Tubes

Miscellaneous Apparatus (such as certain types of keys)

Within each group, the functional designation of apparatus is tabulated in numerical and alphabetical order regardless of the circuit figure in which it appears.

CODE

3.07 In this column are given the code numbers of the various pieces of apparatus. Apparatus listed under magnets is specifically identified. Apparatus listed under relays is specifically identified if other than relays. In some cases additional markings appear adjacent to the relay code. These markings may refer to date or place of manufacture or other special information. There is no tie between the code number and these special markings.

OPTION

3.08 The option shown in this column associates the apparatus with the option shown on the circuit drawing. Fig. 1 shows part of a CRT illustrating the various option combinations.

Note: Prior to 1951, this column was designated FEATURE OR OPTION on attached-contact type circuit drawings.

CKT FIG. (on attached-contact type)
FIG. (on detached-contact type)

3.09 In this column is given the number or letter of the figure or figures in which the apparatus appears.

APPARATUS					OWG. 133.
DESIG.	CODE	OPTION	CRT FIG.	RATING	
					6
					7
CB2	U1466	YA	4	MD	8
					9
CB2	UB1	YB	4	MD	
CB2	UB35	XB	4	STD	
CB3	U136	ZA	1	MD	
CB3	U17	ZB	1	STD	
CB4	U749		2	STD	
FM	U892	Y	6	MD	
FM	UB25	X	6	STD	

- Fig. 1 - Illustrating Feature or Option

RATING (Deleted in 1953 from all CRTs)

3.10 A blank space or the letters STD (standard) opposite a code number in this column indicates that the use of this apparatus is standard for this particular function. If the letters MD (manufacture discontinued) appear, they indicate that the use of the apparatus is no longer standard for this function.

LOC, RESID, OR SEQ SW POS

3.11 General: The heading for this column depends upon the circuit sheets associated with the CRT. If the sheets have coordinates, the heading LOC is used. If the circuit includes step-by-step relays, the heading RESID is used. If the drawings are for panel systems requiring sequence switch adjustment during relay tests, the heading SEQ SW POS is used. If none of the above apply, the column heading is left blank.

3.12 LOC (Location): This column is used to aid in locating the apparatus on the circuit part of the drawing. The coordinate location is given by means of letters and numerals in the same manner that is used to locate points on a map. For example, the notation D18 appearing in this column indicates that the apparatus in question is located on the schematic near the intersection of an imaginary horizontal line through D on the sides of the schematic and an imaginary vertical line through 18 at the top or bottom.

3.13 RESID (Residual): Under this heading are given the residual requirements for step-by-step relays. The minimum and maximum limits are indicated in this column except where SL is specified. The interpretation of all values given under this heading is covered in the apparatus requirements and adjusting procedures for these relays. The numbers indicate values in thousandths of an inch.

3.14 SEQ SW POS (Sequence Switch Position): This column is used on circuits specifying a sequence switch, where it is sometimes necessary to block the switch in some specific position (including the normal position) in order to facilitate the testing and adjusting of some piece of apparatus. The figures shown in this column represent the position in which the sequence switch should be blocked while testing or readjusting that particular piece of apparatus. This column may also be used to indicate rotary (206 or similar type) selector positions if the circuit contains a rotary selector. If the circuit contains a sequence switch or rotary selector and there are no notations made in this column, it is assumed that the sequence switch or selector is in its normal position. In some cases, however, it may advance out of that position unless the selector or switch is blocked.

MECH REQ

BSP FIG.

3.15 The notations in this column are given as numbers or letters. These designations refer to similarly designated spring combination figures, spring combination numbers, adjustments, or contact and winding arrangements in the apparatus requirement and adjusting procedure sections covering the apparatus involved.

3.16 If a relay has only one spring combination, only one figure number or letter is given. Where both top and bottom, or top, middle, and bottom spring combinations are the same, the number or letter is repeated for each combination. If a relay has two or three different spring combinations, a notation is made in this column for each combination. See Table A.

3.17 In some cases springs act only as buffer or balancing springs, and therefore have no contacts. These springs are not shown on the circuit schematic but are shown on the spring combination figure referred to in the BSP FIG. column. For example, the No. 36 spring combination of E- and similar-type relays and the No. 136 spring combination (buffer or balancing spring) of U-, Y-, and similar-type relays typify this type of combination.

3.18 Crossbar-type Switches: The BSP FIG. column notations for crossbar switches refer to the figures showing the selecting (SEL) and holding (HOLD) off-normal spring assemblies in the apparatus requirements and adjusting procedures section covering these switches. The selecting off-normal spring assembly may consist of centering springs or of a combination of centering springs and contact springs. Similarly, the holding off-normal spring assembly may consist of balancing springs or of a combination of balancing springs and contact springs.

CONT PRESS.

3.19 In the column headed CONT PRESS., is given the contact pressure requirements for only E-, F-, H-, R-, T-, U-, Y-, EA-, UA-, and UB-type relays as defined in the individual apparatus requirements and adjusting procedures sections. The notations H (high), L (low), and SPL (special) are shown in this column to designate the contact pressure of a relay. The letters H and L indicate which particular set of tensions, associated with a particular figure or figures in the apparatus requirements and adjusting procedures sections should be used. The designation SPL indicates that the contact pressure or related requirement affecting contact pressure is special and as such is covered by a test note, referred to in the SEE TEST NOTE column, or in the REMARKS column.

Table A - Explanation of Typical Examples Where BSP FIG Column Shows a Letter or Figure Number Corresponding to that in the apparatus requirement and adjusting procedure section

Relay Types	BSP FIG. Column Shows	Spring Combination		
		Top	Middle	Bottom
A,122,125, 178, and similar types	H H/H H/H/H A/C/F	H H H A	- - H C	- H H F
E,R,U,Y, and similar types	2 2/- 2/2 25/14 25/36 (See 3.17) 132/106	2 2 2 25 25 132	- - - - - -	- - 2 14 36 106
B,G,J, and similar types	Number	Numbered in accordance with spring combination in apparatus requirement and adjusting procedure section.		
221,224, 247,251, and similar types	Number	On these relays a single figure applied to one combination, whether a single assembly, or a combination of 2 assemblies.		
245 and similar types (multi-contact)	50 Cont, 60 Cont or 1/2 50 Cont or 1/2 60 Cont	When the designation 1/2-50 or 1/2-60 appears in this column opposite a 245 or similar relay, it indicates that only 1/2 of this relay is used for this function.		
215,227, and iron 206 types	Number	Numbered in accordance with adjustment in apparatus requirement and adjusting procedure section.		
231,239, and permalloy 206 types (See also 3.26)	Number or Letter	Earlier issues show number, later issues show letter in accordance with adjustment in apparatus requirement and adjusting procedure section.		
266,275, and 276	Number	Numbered in accordance with winding and contact arrangement of apparatus requirement and adjusting procedure section.		
280	A or B	Lettered in accordance with adjustment in apparatus requirement and adjusting procedure section.		
AF, AG, and AJ wire-spring types	Number or Number and Letter B	Numbered in accordance with spring combination in apparatus requirement and adjusting procedure section. Letter B indicates relay is equipped with a buffer spring.		

ARM. TRVL

3.20 The column headed ARM. TRVL is used for giving the armature travel requirements for relays as defined in the individual apparatus requirement and adjusting procedure sections. Where SPL is specified, the armature travel is special, that is, it differs from the standard requirements for this particular relay code or spring combination. Such special requirements are given in a test note referred to in the SEE TEST NOTES column or in the REMARKS column. The value shown in this column is expressed in thousandths of an inch.

CIRCUIT PREPARATION

3.21 The circuit preparation and connection points necessary for the application of current flow requirements are covered in the following columns.

BLOCK OR INSULATE

3.22 In this column, information is given for blocking apparatus in either the operated O or nonoperated NO position, or insulating contacts. This information is covered as follows.

3.23 BLOCK: If apparatus is to be blocked, this column shows the designation followed by O for operated or NO for nonoperated.

Example 1: (A)O indicates that the A relay should be blocked in the operated position.

Example 2: (C)NO indicates that the C relay should be blocked in the nonoperated position to prevent its operation.

3.24 INSULATE: If a contact is to be insulated, this column shows the number of the contact followed by the apparatus designation.

Example: 1(A) means to insulate contact 1 of the A relay. 6 (VON) means to insulate contact 6 of the vertical off-normal springs. If the number of a contact given is that of the moving spring of a transfer (break-before-make) or the common spring of a continuity (make-before-break) combination, the contacts should be insulated from both the break and make contacts.

TEST CLIP DATA

3.25 The subheading TEST CLIP DATA is divided into two columns, CONN BAT. and CONN GRD. These columns cover references to the particular point or points in the circuit under test to which the test set lead or leads are to be connected in making the specified electrical test. The point to which the test set lead furnishing battery through the test set is to be connected is indicated in the column headed CONN. BAT. The point to which the test set lead furnishing ground through the test set is to be connected is indicated in the column headed CONN. GRD except as covered in 3.53. The designation not in parentheses is that of the winding or contact spring to which connection is to be made. This is followed by the circuit designation in parentheses of the apparatus involved. See Section 005-120-102 to 104 for the method of designating the winding and contact terminals. When MAG TST, REL TST, or REL UNDER TST is specified in the CONN. BAT. or CONN. GRD column, it means that connection shall be made to the specified point of the particular apparatus under test.

3.26 Polarized Relays: If a winding of a polarized relay or other apparatus is connected directly to the terminals of a jack, use an appropriate cord and plug inserted into the jack for connecting the relay to the test set. This procedure is referred to by note on some CRTs.

TEST SET PREP

3.27 In this column is given information indicating the way in which the test set is to be applied to the circuit under test. The designations generally used, are listed in Table B below. The applications described apply except for testing of 206- and similar-type selectors. Sections 026-706-711 and 026-706-712 cover the explanations of test set preparations used in testing the selectors. Test set applications can in general be divided into three classes, namely; current flow applications (3.28 to 3.39), potential drop applications (3.40 to 3.42), and other applications (3.43).

Table B - List of Test Set Preparations

Notation	Meaning	Described in Par.	Fig.
ABG	Alternate battery and ground	3.39	11
AC/V	Alternating-current voltage	3.41	18
BAT.	Battery (negative)	3.34	6
+BAT.	Positive battery	3.35	7
B/G	Battery and ground (negative)	3.36	8
+B/G	Positive battery and ground	3.37	9
B/G/V	Battery and ground voltage	3.41	16,17
B/V	Battery voltage	3.41	14,15
+CN BAT.	Positive coin battery	3.35	7

Notation	Meaning	Described in Par.	Fig.
-CN BAT	Negative coin battery	3.34	6
+130	Positive 130V	3.35	7
-130	Negative 130V	3.34	6
F/V	Fuse voltage	3.42	18
GRD	Ground (positive)	3.32	4
-GRD	Negative ground	3.33	5
G/V	Ground voltage	3.41	12,13
M	Metallic	3.31	3
NGB	Nongrounded battery	3.38	10
V-M	Variable make	3.43	-
V-BR	Variable break	3.43	-
24V	24V battery	3.34	6
24 V/G	24V battery and ground	3.36	8
48 V/G	48V battery and ground	3.36	8

Current Flow Applications

3.28 Current flow applications are those used to describe the application of electrical requirements to electromagnetic apparatus by means of a current flow test set. The primary function of a current flow test set (35-type test set) is to control the amount of current flow through the winding of the apparatus while it is being tested or adjusted. This is usually accomplished by means of an adjustable resistor in series with a milliammeter and control key in the test set as shown in Fig. 2.

3.29 Additional information regarding test set preparations may be specified in the REMARKS column or in TEST NOTES.

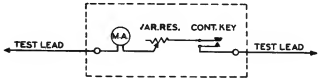


Fig. 2 - Fundemental Current Flow Test Circuit

3.30 Types of Current Flow Applications: The current flow tests may be applied to the apparatus to be tested or adjusted in several ways. The application specified is dependent on the following:

(1) How the apparatus is wired in the circuit.

(2) Whether battery or ground is obtainable from the circuit under test or will have to be supplied through the test set.

(3) The ease with which the test leads can be applied to points in the circuit.

The various current flow test set connections are listed in Table B. Details for the method of making the test set connections are covered by the section describing the use of the 35-type test sets. The following paragraphs describe the current flow connections in detail.

3.31 M (Metallic): Fig. 3 - If M is specified, battery and ground are furnished by the circuit under test. In this case, the test set circuit is applied across the points of the circuit as specified in the TEST CLIP DATA column.

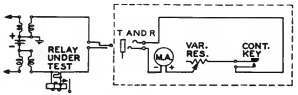


Fig. 3 - M (Metallic) Application

3.32 GRD (Ground): Fig. 4 - Where GRD is specified, the positive side of the battery of the circuit under test is connected to ground. The GRD lead of the test set circuit is connected to ground and the R lead of the test set circuit is connected to the point in the circuit under test specified in the CONN GRD column. See also 3.53.

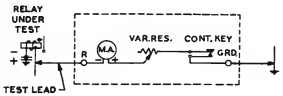


Fig. 4 - GRD (Ground) Application

3.33 -GRD (Negative Ground): Fig. 5 - If -GRD is specified, the negative side of the battery of the circuit under test is connected to ground. The BAT. of the test set circuit is connected to ground, and the T lead of the test set circuit is connected to the point in the circuit under test specified in the CONN.GRD column. See also 3.53.

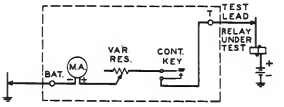


Fig. 5 - -GRD (Ground) Application Where Positive Battery Is Used

3.34 BAT. (Negative Battery): Fig. 6 - If BAT. is specified, the positive side of the battery of the circuit under test is connected to ground. The BAT. lead of the test set circuit is connected to negative battery and the T lead of the test set circuit is connected to the point in the circuit under test specified in the CONN. BAT. column. See also 3.53.

Note: If it is necessary to test or adjust the apparatus on a specific voltage other than that generally used in the office, this voltage is specified in the TEST SET PREP column instead of BAT. Typical examples are -CN BAT. and 24V.

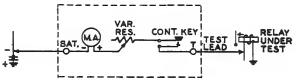


Fig. 6 - BAT. (Battery) Application

3.35 +BAT (Positive Battery): Fig. 7 - If +BAT. is specified, the negative side of the battery of the circuit under test is connected to ground. The GRD lead of the test set circuit is connected to positive battery and the R lead of the test set circuit is connected to the point in the circuit specified in the CONN. BAT. column. See also 3.53.

Note: If it is necessary to test or adjust the apparatus on a specific voltage other than that generally used in the office, this voltage is specified in the TEST SET PREP column instead of BAT. A typical example is +CN BAT.

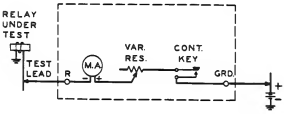


Fig. 7 - +BAT (Positive Battery) Application

3.36 B/G (Battery and Ground): Fig. 8 - If B/G is specified, neither battery nor ground is furnished by the circuit under test. The BAT. and GRD leads of the test set circuit are connected to battery and ground and the T and R leads of the test set circuit are connected to the points of the circuit specified in the CONN. BAT. and CONN. GRD columns.

Note: If 24 V/G, 48 V/G, or any other V/G appears in the TEST SET PREP column, the B/G type of connection must be used with the specific voltage indicated.

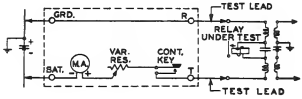


Fig. 8 - B/G (Battery and Ground) Application

3.37 +B/G (Positive Battery and Ground): Fig. 9 - Where +B/G is specified, neither battery nor ground is furnished by the circuit under test. The GRD and BAT. leads of the test set circuit are connected

to battery (positive) and ground, and the R and T leads of the test set circuit are connected to the points of the circuit specified in the CONN. BAT. and CONN. GRD columns.

Note: If +24 V/G, +48 V/G, or any other +V/G appears in the TEST SET PREP column, the +B/G type of connection must be used with the specific voltage indicated.

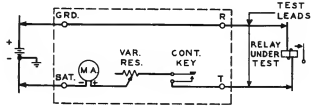


Fig. 9 - B/G (Positive Battery and Ground) Application

3.38 NGB (Nongrounded Battery): Fig. 10 - The following information applies to this notation:

(a) If NGB is specified, the BAT. terminal of the test set is connected to the negative side of an auxiliary battery and the GRD terminal of the test set is connected to the positive side of the auxiliary battery. The negative side of the battery through the test set T lead is connected to the point in the circuit specified in the CONN. BAT. column. The positive side of the battery through the test set R lead is connected to the point in the circuit specified in the CONN GRD column.

(b) If a current flow test set is used to apply an NGB application, the auxiliary battery is connected directly to the TEST BAT. & GRD jack of the test set by means of a patching cord.

3.39 ABG (Alternate Battery and Ground): Fig. 11 - The following information applies to this notation:

(a) If ABG is specified, the positive side of the battery of the circuit under test is connected to ground. The BAT. and GRD terminals of the test set circuit are connected to 48-volt battery (negative) and ground, respectively. The T lead of the test set circuit is connected to the point in the circuit under test specified in the CONN. BAT. column.

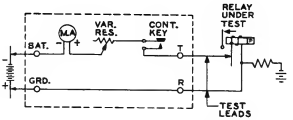


Fig. 10 - NGB (Nongrounded Battery) Application

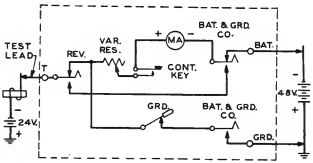


Fig. 11 - ABG (Alternate Battery and Ground) Application

(b) ABG is used to apply a soak to the relay in the reverse direction to the operating current where one side of the relay is permanently conected to 24-volt battery (negative). The change in the direction of current flow through the relay is obtained by switching from BAT. to GRD in the test set circuit.

Potential Drop Applications

3.40 The potential drop method of testing and adjusting apparatus has been discontinued as far as practicable. Current flow requirements are being established wherever possible. Where it is necessary to isolate the apparatus under test to permit applying the current flow requirements, the information is covered by a TEST NOTE or in the REMARKS column of the CRT.

3.41 G/V (Ground Voltage) (Figs. 12 and 13), B/V (Battery Voltage) (Figs. 14 and 15), B/G/V (Battery and Ground Voltage) (Figs. 16 and 17) and AC/V (Alternating-current Voltage) (Fig. 18): If these

notations are specified in the TEST SET PREP column, the electrical requirements are given in the TEST MA. and READJ MA. columns in terms of voltage across the winding terminals of the apparatus under test. Figs. 12 to 18, inclusive, show the use of potential drop requirements using either the voltmeter in the 35-type test set or an external voltmeter. In the later type of current flow test set, the volt-milliammeter may be used as a voltmeter and no external voltmeter is necessary. In the case of AC/V the J68602AH or J68602AJ, AC test set is used. These notations represent test set circuit applications similar to the GRD, BAT., and B/G applications with the exception that, in addition, a voltmeter is bridged across the winding of the apparatus under test. The test set in these cases is merely used as a resistor to establish the desired drop of potential across the winding.

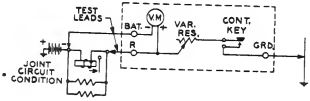


Fig. 12 - G/V (Ground Voltage) Application Using No. 35D or 35F Test Set

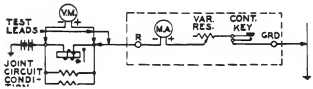


Fig. 13 - G/V (Ground Voltage) Application Using No. 35C Test Set and External Voltmeter

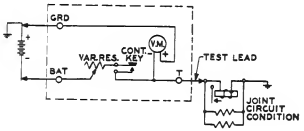


Fig. 14 - B/V (Battery Voltage) Application Using No. 35D or 35F Test Set

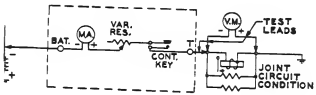


Fig. 15 - B/V (Battery Voltage) Application Using No. 35C Test Set and External Voltmeter

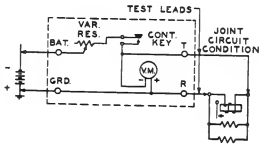


Fig. 16 - B/G/V (Battery and Ground Voltage) Application Using Nos. 35D and 35F Test Sets

(c) Some relays may be adjusted on either voltage or current. When this is the case, one line is used on the CRT to indicate voltage limits, and another line is used to indicate current limits. An explanation of these requirements is given in the REMARKS column.

(d) If a relay functions on ringing current and has requirements other than direct-current flow requirements, one of the following notations is specified in this column.See (e) for ac voltage.

AC - If only AC is specified in these columns, the requirements are shown either in the REMARKS column or in a Test Note referred to in the SEE TEST NOTE column.

Numerical Values AC - A numerical value followed by the notation AC indicates that the value is an alternating-current value.

(e) Where AC/V or a value followed by V is specified in this column, the requirement is a voltage requirement. If the voltage is ac, the REMARKS column covers this by the note AC VOLTAGE REQUIREMENT FOR.....CYCLES.

(f) See 3.45 for an interpretation of the negative sign (-) sometimes shown in this column.

(g) On a single-wound relay,test and readjust values are, in general, specified in these columns for each electrical function (operate, nonoperate, hold, or release) for which a requirement is specified. However, on apparatus which cannot or should not be adjusted (such as line message registers or 275- and 276-type relays), test values only are specified.

(h) On one winding of a multiwound relay, or on two or more windings connected in series or parallel, test and readjust values are specified for all electrical functions required of the relay. Test values only are specified for the other windings for each electrical condition which those windings are required to meet.

A and B Adjustments As Indicated in BSP FIG. Column For Polarized Relays

(i) Readjust operate and nonoperate values shown in the first two lines of the electrical requirements, or corresponding values on subsequent lines in the case of parallel requirements, are used to obtain the electrical balance for A and B adjustments. In the case of the B adjustment, the biasing spring is disengaged from the armature for application of these values. For the B adjustment, readjust values shown on other lines are applied with the biasing spring engaging the armature of the relay.

(j) No test values are shown in the first two lines of the electrical requirements in the case of the B adjustment. All test values for the B adjustment shown on other lines are applied with the biasing spring engaging the relay armature.

(k) Parallel Combination Current Flow Requirements: Unless otherwise specified, if a winding is permanently wired in multiple with another current path such as a resistor or a winding of other apparatus, so that it would be necessary to unsolder the winding to test it separately, the winding should be tested and readjusted on the joint current. In such cases where the values are given for the multiple current path, a note is specified either in the SEE TEST NOTE NO. or the REMARKS column that requirements are for circuit combination of .. (naming all apparatus involved). In addition, test and readjust requirements are given for the winding alone. This procedure of providing current values for the individual winding in addition to current values for the multiple path, is followed in order to provide for a bench check on the relay whenever it is found necessary to remove a relay from the circuit or to substitute a new relay.

REMARKS or TIME REQ

3.52 The last column is headed either REMARKS, or TIME REQ, the latter heading being used only in connection with step-by-step relays.

REMARKS

3.53 Information in the column headed REMARKS covers a brief description of special conditions applying to the apparatus. Where CONN. DIRECT BATTERY or CONN. DIRECT GROUND and a connecting point is specified in this column, it indicates that direct battery or direct ground should be connected to the indicated point. This information is in addition to the information specified in the TEST SET PREP column. Where a note specifies a per cent break requirement for pulse repeating relays, refer to the apparatus requirement and adjusting procedures sections for additional information for testing the relay.

TIME REQ (Step-by-Step Relays Only)

3.54 The heading TIME REQ covers two columns having the subheadings TEST and READJ. These columns contain the timing requirements for step-by-step relays. The terms are given in seconds. These requirements supplement the direct-current flow requirements specified for testing and adjusting the relays. The requirements should be applied as covered in the apparatus requirement and adjusting procedure section for these relays.

INFORMATION ON ELECTRON TUBES

3.55 Information for electron tubes, if required, is shown after the apparatus listings on the CRT. If no information is specified for electron tubes, the tubes should be tested on standard electron tube test equipment. If the REMARKS column specifies SEE BSP, reference should be made to the section covering the equipment.

3.56 Electron Tube Tests: Information concerning requirements for electron tubes permanently wired in the circuit appears after the apparatus listings on the CRT, as shown in Fig. 20. The tube designations and codes are listed in the columns headed DESIG and CODE. Blocking information is covered in the BLOCK or INSULATE column and the SEE TEST NOTE NO. column refers to a small table which appears under TEST NOTES. This table covers the voltage requirements applying to the tubes when these requirements differ from those in Section 024-707-701. The values given should be checked by means of the electron tube test set, J24754A. The column headings have the following meaning:

SG ION - The voltage drop across the starter gap following ionization on the voltage drop test of the electron tube test set.

AG DROP - The voltage drop across the anode gap caused by the anode current following ionization.

AG FWD POT. - The forward or working voltage applied across the main gap of the tube under test at which the tube should not ionize.

TABLES HEADED - TIMING REQUIREMENTS

3.57 The term TIMING REQUIREMENTS is used to cover both

(1) Timing requirements applied by the timing test set.

(2) Requirements expressed in pulses per second and per cent break of the pulse cycle.

CIRCUIT REQUIREMENTS								
APPARATUS				CIRCUIT PREPARATION				
DESIG.	CODE	FEATURE OR OPTION	CKT. FIG.	BLOCK OR INSULATE	TEST CLIP DATA CONN BAT	CONN GRD	TEST SET PREP	SEE TEST NOTE NO.
ELECTRON TUBES								
CH	346B			IT(F)				
				3T(F)				1

TEST NOTES:
1. USE ELECTRON TUBE TEST SET. CONNECT BK TO IT (F) AND W TO 5T (F)
TEST REQUIREMENTS FOR THE NO. 346B TUBE ARE:

	SG ION	AG DROP (AT 20 MA)	AG FWD POT
MIN. VOLTS	62	72	—
MAX. VOLTS	69	90	80

Fig. 20 - Method Of Showing Requirements For Wired-in Electron Tubes

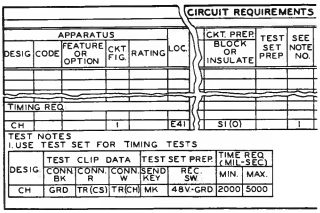
3.58 Timing requirements are in some cases necessary for relays and timed relay interrupter circuits. The requirements supplement direct-current flow requirements specified for testing and adjusting the relays.

Tables Where Timing Test Set Is Specified

3.59 Generally, if in relays the circuits have timing requirements, these are shown on one or more pages headed TIMING REQUIREMENTS following the regular pages showing circuit requirements as shown in Fig. 36. If only a few relays have timing requirements, these may be given in an auxiliary timing requirements table which is generally located under TEST NOTES following the apparatus listings on the CRT as shown in Fig. 21. In general, the information covered in both cases is the same although the forms differ somewhat. In some cases, additional columns are included under timing requirements as covered in 3.70 and 3.71.

3.60 The timing requirement table is divided into main headings which are further subdivided as follows:

Column Heading		Described in
APPARATUS		3.07-3.10,3.61
DESIG		3.61
CODE	See note 1	3.07
FEATURE OR OPTION		3.08
CKT FIG.	See note 2	3.09
RATING	See note 3	3.10



	APPARATUS					CIRCUIT REQUIREMENTS		
DESIG	CODE	FEATURE OR OPTION	CKT FIG.	RATING	LOC.	CKT PREP BLOCK OR INSULATE	TEST SET PREP	SEE NOTE NO.
TIMING REQ.								
CH	-	-	1	-	E41	ST(O)		1

TEST NOTES
1. USE TEST SET FOR TIMING TESTS

DESIG.	TEST CLIP DATA				TEST SET PREP	TIME REQ (MIL-SEC)	
	CONN BK	CONN R	CONN W	SEND KEY	REC SW	MIN.	MAX.
CH	GRD	TR(CS)	TR(CH)	MK	48V-GRD	2000	5000

Fig. 21 - Method of Showing Timing Requirements on Circuit Requirement Table for Other Than Step-by-Step Relays

Column Heading		Described in
CIRCUIT PREPARATION		3.62,3.63
BLOCK OR INSULATE		3.62
TEST CLIP DATA		3.63
CONN. BK		3.63
CONN. R		3.63
CONN. W		3.63
TEST SET PREP.		3.64,3.65
SEND KEY		3.64
REC SW		3.65
START		3.65
STOP		3.65
SEE TEST NOTE NO.	See note 4	3.66
TEST FOR	See note 5	3.67
TIME REQ (MIL-SEC.)		3.68-3.71
MIL-SEC.		3.68
MIN		3.68
MAX		3.68
ADJUST POT.	See note 6	3.70
FOR MIL-SEC.	See note 6	3.71
REMARKS		3.69

Note 1: Column omitted on detached-contact circuit drawings; on attached-contact circuit drawings, where specified, it gives the code of apparatus used for obtaining the timing.

Note 2: Designated FIG. on detached-contact circuit drawings.

Note 3: Column omitted on detached-contact circuit drawings; deleted from attached-contact circuit drawings in 1953.

Note 4: Designated SEE NOTE on detached-contact circuit drawings.

Note 5: Column omitted on detached-contact circuit drawings.

Note 6: Used only on certain drawings of either type.

APPARATUS

DESIG

3.61 In this column is given the functional designation of the timer for which the timing requirements are listed. The timers are listed as far as possible in numerical and alphabetical order of designations.

CIRCUIT PREPARATION

BLOCK or INSULATE

3.62 In this column is given information for blocking relays or insulating contacts incidental to making a timing test. A description of the information covered in this column is covered in 3.22 to 3.24.

TEST CLIP DATA

3.63 This column is subdivided as follows:

CONN. BK
CONN. R
CONN. W

In these columns are given the points in the circuit to which the black (BK), red (R), and white (W) leads of the test set for timing tests are to be connected.

TEST SET PREP.

SEND KEY

3.64 In this column is given the position that the SEND key should be in to make the test involved.

REC SW

3.65 This may be a single column headed REC SW or may be further subdivided into two columns headed START and STOP. The combined notations in either case represent the position that the REC SW of the test set for timing tests should

be in to make the test.

SEE NOTE (On detached-contact drawings)
SEE TEST NOTE NO. (On attached-contact drawings)

3.66 In this column are given the numbers of the test notes which give special information required to make the timing tests.

TEST FOR

3.67 In this column are given the notations O or R to indicate tests for operate or release times, respectively.

Note: This column omitted on detached-contact circuit drawings.

TIME REQ (MIL-SEC.)

3.68 This column is subdivided into two columns headed MIN and MAX. In these columns, the minimum and maximum limits of the timing requirements are expressed in milliseconds.

REMARKS

3.69 In this column are given brief notes covering special conditions applying to the timing tests.

ADJUST POT.

3.70 In this column is given the designation of the potentiometer to be used in adjusting the circuit within the time limits given in the FOR MIL-SEC. columns.

FOR MIL-SEC.

3.71 This column is subdivided into two columns MIN and MAX. In these columns are given the values within which the circuit should be adjusted using the potentiometer specified in the ADJUST POT. column. When the FOR MIL-SEC. column and ADJUST POT. are used, no information is given in the column TIME REQ.

Table Where Pulse Speed and Per Cent Break Are Specified

3.72 Timing requirements for relay interrupter circuits are given on the last page of the circuit requirement table in one of the following ways:

(a) Pulse speed in pulses per second and per cent break of the pulse cycle expressed numerically, 3.73 and 3.74.

(b) Make and break periods of the pulse cycle expressed in mil-seconds, 3.75 and 3.76.

(c) Pulse speed expressed in pulses per second and per cent break expressed in graphical chart form, 3.77 to 3.81.

Requirements Covering Pulse Speed in Pulses per Second and Per Cent Break Expressed Numerically

3.73 The column under APPARATUS, Fig. 22, is divided into two parts headed PULSE CYCLE % BREAK and PULSE SPEED. The columns are each further subdivided into two parts headed MIN and MAX. The figures given in these columns represent the minimum and maximum per cent break and the minimum and maximum number of pulses per second that the interrupter is required to furnish.

3.74 The BLOCK or INSULATE columns cover the blocking and insulating information necessary to secure readings on the per cent break meter and impulse counter used in making this check. The information in the columns headed CONN.T and CONN.R shown under the CONN.BAT. and CONN.GRD columns refer to the points in the circuit under test to which the T (tip) and R (ring) terminals of the test jack in the testing equipment is to be connected.

SD-XXXXX-XX 2 PAGES						CIRCUIT REQUIRE RELAY INTERRUPTER CIRCUIT					
APPARATUS						CIRCUIT PREPARATION				TEST SET PREP	SEE TEST NOTE NO.
DESIG	CODE	FEATURE OR OPTION		CKT. FIG.		BLOCK OR INSULATE	TEST CLIP DATA				
							CONN.BAT	CONN.GRD			
		PULSE CYCLE % BREAK		PULSE SPEED							
		MIN.	MAX.	MIN.	MAX.		CONN.T	CONN.R			
P	239CG	37	43	9.9	11.1	(T1) O	BRUSH(A) SEL-ARC			BAT.	2/3
P1	239GF										

Fig. 22 - Portion of Circuit Requirement Table Showing Capacitor Timed Relay Interrupter Requirements Expressed in Pulsing Speeds and Per Cent Break of Pulse Cycle

Requirements Covering Make and Break Intervals of the Pulse Expressed in Mil-seconds

3.75 The supplementing column under APPARATUS, Fig. 23, is headed PULSE TIME IN MIL-SECS. and is subdivided into two columns with headings BREAK and MAKE.

These columns are further subdivided into two parts headed MIN and MAX. The figures given in these columns represent the minimum and maximum make and break periods in seconds which the interrupter is required to furnish.

3.76 The BLOCK OR INSULATE columns cover the blocking and insulating information necessary to secure readings on the per cent break meter and impulse counter used in making this check. The information in the columns headed CONN. R and CONN. T shown under the CONN. BAT. and CONN. GRD. columns refer to the points in the circuit under test to which the T (tip) and R (ring) terminals of the test jack in the testing equipment is to be connected.

SD-XXXXX-XX 2 PAGES						CIRCUIT REQUIRE					
						RELAY INTERRUPTER CIRCUIT					
APPARATUS						CIRCUIT PREPARATION			TEST SET PREP		SEE TEST NOTE NO.
DESIG.	CODE	FEATURE OR OPTION	CKT. FIG.			BLOCK OR INSULATE	TEST CLIP DATA CONN. BAT.	CONN. GRD.			
		PULSE TIME IN MIL-SECS.									
		BREAK		MAKE							
		MIN.	MAX.	MIN.	MAX.		CONN. T.	CONN. R.			
KP2	239GF	36	42	47.5	55.5		A330CJ-K	A330CJ-K	B/G		3
KP3		226	284	221	280	(SKP) O	A330CJ-K	A330CJ-K	B/G		3
KP4											

Fig. 23 - Portion of Circuit Requirement Table Showing Requirements Expressed in Pulse Time in Mil-seconds

Requirements Covering Pulse Speed in Pulses per Second and Per Cent Break in Graphical Chart Form

3.77 The pulse requirements (pulse speed and per cent break) are also presented in graphical form by charts as shown in Figs. 24, 25, 26, and 27. Per cent break values are shown on one scale and pulse speed in pulses per second on the other scale of the charts. The per cent break and pulse per second values, as indicated by the test equipment, are located on these scales when checking the apparatus to the pulse requirements. The point of intersection of the horizontal and vertical lines through these points on the scales show whether the apparatus meets the requirements. The requirements are met if the point of intersection lies in the area bounded by the solid lines defining the pulse limits on the chart.

3.78 These charts may also indicate whether the circuits include adjustable resistors or capacitors for regulating the apparatus to meet the pulse requirements. A chart, Fig. 24, composed only of solid lines defines pulse limits, and the circuit may or may not include means for pulse regulation. The addition of dash lines and associated designations to a chart shows that means for pulse regulation are included in the circuit. The charts in Figs. 25, 26, and 27 show that the circuits include adjustable resistors for this purpose. Resistor or capacitor designations may be placed with relation to the dash lines to indicate the adjustment necessary to bring the apparatus within requirements as described in 3.79 to 3.81, inclusive. The adjustable resistors or capacitors are used only when the apparatus has been found to be within electrical and mechanical requirements, and yet does not meet the pulse requirements. These charts vary in size and shape depending upon the particular requirements involved. The following paragraphs describe in detail the various designations used on these charts.

3.79 The chart in Fig. 25 shows the pulse requirements for the PLS relay the limits of which are defined by the closed solid lines. These lines are extended as dash lines, which together with associated designations show that adjustable resistors K and L are included in the circuit to regulate the pulsing of the PLS relay. If the PLS relay does not meet the pulse requirements, the point representing the per cent break and speed values will lie in one of the eight areas partially bounded by the dash lines. The designations RES K and RES L together with the plus (+) or minus (-) signs in each area show the adjustment of the adjustable resistor required to bring the PLS relay within the pulse limits. The plus (+) sign indicates that the resistance should be increased and the minus (-) sign that it should be decreased for this purpose.

Example 1: If the per cent break of the relay is 52 per cent and the speed 26 pulses per second, as measured by the test equipment, the point of intersection of the lines corresponding to these values on the chart lies within the area bounded by the solid lines. This shows that the relay meets the pulse requirements.

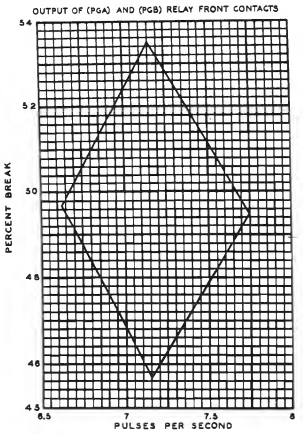


Fig. 24 - Pulse Requirements Shown in Graphical Form - No Variable Resistors or Capicators in Circuit to Regulate Pulsing

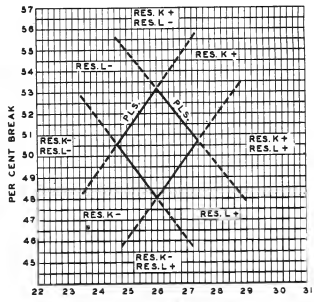


Fig. 25 - Pulse Requirements Shown in Graphical Form - Variable Resistors in Circuit to Regulate Pulsing

Example 2: If the per cent break of the relay is 50 per cent and the speed 28 pulses per second as measured by the test equipment, the point of intersection of the lines corresponding to these values on the chart lies within the area at the right designated RES K+; RES L+. This shows that, provided the PLS relay meets the mechanical and electrical requirements, increasing the resistance of the K and L resistors will bring the relay within the pulse limits.

3.80 The chart in Fig. 26 shows the pulse requirements for two associated pulsing relays PLS and CTG, the pulsing of which can be regulated by the same adjustable resistors. In this case, the pulsing of each of these relays can be checked independently. The PLS relay portion of the chart consists of the four solid lines designated PLS. These lines are extended in dash lines the same as on the chart for the PLS relay in Fig. 25 and this portion of the chart is read the same as the previous chart described in 3.79. The pulse requirements for the CTG relay are shown by the six solid lines designated CTG. The dash lines of the PLS chart extend beyond the CTG chart and apply to the CTG relay in the areas outside the solid lines of the CTG chart.

Example 1: A reading of 65 per cent break and 25 pulses per second on the PLS relay would show that this relay is outside the pulse limits bounded by the PLS chart. In this case, the chart shows that, decreasing the resistance of the N resistor will bring the relay within the pulse limits, provided the electrical and mechanical requirements for the relay are met. The same readings of per cent break and pulse speed taken on the CTG relay would show that its pulsing requirements are met, since the point representing these values lies within the solid lines of the CTG chart.

Example 2: A reading of 65 per cent break and 28 pulses per second taken on either the PLS or CTG relay would show the relay to be outside the specified limits. In this case, the chart shows

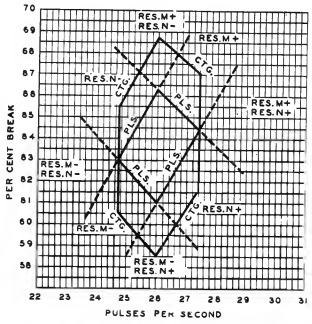


Fig. 26 - Pulse Requirements Shown in Graphical Form - Charts for Two Relays PLS and CTG - Pulsing Regulated by Same Variable Resistors - Output of Relays Checked Independently

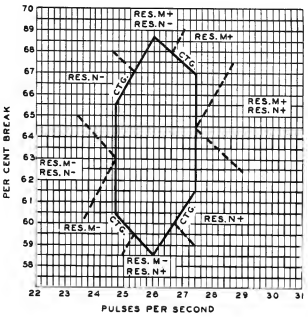


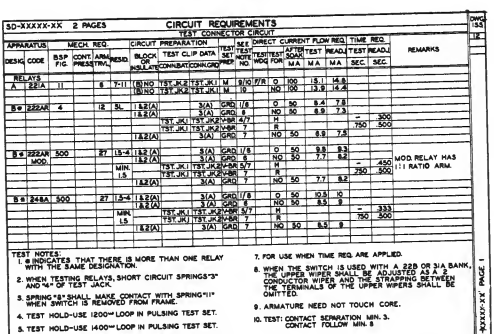
Fig. 27 - Pulse Requirements Shown in Graphical Form - Chart for Pulse Delivery Relay CTG - Pulsing of CTG and Associated Relay (Not Shown) Regulated by Same Variable Resistors - Facilities Provided for Checking Output of CTG Relay Only

that increasing the resistance of both the M and N resistors will bring the pulsing of the relay within limits provided the electrical and mechanical requirements of the relay are met.

3.81 The chart in Fig. 27 illustrates the pulse requirements for two associated relays, the CTG and a second relay not shown on the chart. While the pulsing of both relays can be regulated by the same adjustable resistors designated on the chart, the circuit provides facilities for checking the output of the pulse delivery CTG relay only. For this reason, requirements for the second relay are not included on the chart. This chart is the same as that shown in Fig. 26 with the information for the PLS relay removed, and the interpretation of this chart is the same as that for the CTG relay portion of the chart shown in Fig. 26 and described in 3.80.

4. CIRCUIT REQUIREMENT TABLES STANDARD FROM 1925 TO 1947

4.01 The circuit requirement tables, as shown in Figs. 28 to 31 are similar to the CRT shown in Fig. 1 except that the columns headed FEATURE OR OPTION, CKT FIG., and RATING are missing. The notations on these columns have the same meanings as similarly headed columns in the present CRT. (See Index, page 2.) The points of difference in the information in the columns in these tables and the present tables are covered in the following paragraphs.



CIRCUIT REQUIREMENTS

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TEST CONNECTOR CIRCUIT

ISS 12

APPARATUS DESIG	CODE	MECH. REQ. BSP FIG.	CONT. ARM PRESS TRVL	RESID.	CIRCUIT PREPARATION BLOCK OR INSULATE	TEST CLIP DATA	TEST SET NOTE	TEST NO.	MEK DIRECT CURRENT FLOW REQ. TEST WDG/OHM	AFTER SOAK	TEST MA	READ MA	TEST MA	READ MA	TIME REQ. TEST SEC.	TIME REQ. READ SEC.	REMARKS
RELAYS																	
A	22EA	11		6	7-11	(B) NO TST. JK 2		M	9/10 F/R		O	100	15.1	14.8			
						(B) NC TST. JK 2	TST. JK 1	M	10		NO	100	13.9	14.4			
B 9	22EAR	4		12	5L	1 & 2 (A)		3 (A)	GRD. 1/8		O	50	8.4	7.8			
						1 & 2 (A)		3 (A)	GRD. 8		NO	50	8.9	7.3			
							TST. JK 1	TST. JK 2	VBR 4/7		H				-	300	
							TST. JK 1	TST. JK 2	VBR 7		R				750	300	
						1 & 2 (A)		3 (A)	GRD. 7		NO	50	8.9	7.8			
B 6	22EAR MOD.	500		27	1.5-4	1 & 2 (A)		3 (A)	GRD. 1/8		O	50	9.8	8.3			
						1 & 2 (A)		3 (A)	GRD. 8		NO	50	7.7	6.2			MOD. RELAY HAS 1:1 RATIO ARM.
				MIN. 1.5			TST. JK 1	TST. JK 2	VBR 5/7		H				-	450	
							TST. JK 1	TST. JK 2	VBR 7		R				750	300	
						1 & 2 (A)		3 (A)	GRD. 7		NO	50	7.7	6.2			
B 8	24BA	500		27	1.5-4	1 & 2 (A)		3 (A)	GRD. 1/8		O	50	10.5	10			
						1 & 2 (A)		3 (A)	GRD. 8		NO	50	8.5	9			
				MIN. 1.5			TST. JK 1	TST. JK 2	VBR 5/7		H				-	333	
							TST. JK 1	TST. JK 2	VBR 7		R				750	300	
						1 & 2 (A)		3 (A)	GRD. 7		NO	50	8.5	9			

TEST NOTES:

1. ⊕ INDICATES THAT THERE IS MORE THAN ONE RELAY WITH THE SAME DESIGNATION.
2. WHEN TESTING RELAYS, SHORT CIRCUIT SPRINGS "3" AND "4" OF TEST JACK.
3. SPRING "8" SHALL MAKE CONTACT WITH SPRING "11" WHEN SWITCH IS REMOVED FROM FRAME.
4. TEST HOLD-USE 1200Ω LOOP IN PULSING TEST SET.
5. TEST HOLD-USE 1400Ω LOOP IN PULSING TEST SET.
6. FOR MTCE. ONLY WHEN TIME REQ. ARE NOT APPLIED.
7. FOR USE WHEN TIME REQ. ARE APPLIED.
8. WHEN THE SWITCH IS USED WITH A 22B OR 31A BANK, THE UPPER WIPER SHALL BE ADJUSTED AS A CONDUCTOR WIPER AND THE STRAPPING BETWEEN THE TERMINALS OF THE UPPER WIPERS SHALL BE OMITTED.
9. ARMATURE NEED NOT TOUCH CORE.
10. TEST: CONTACT SEPARATION MIN. 3. CONTACT FOLLOW MIN. 8

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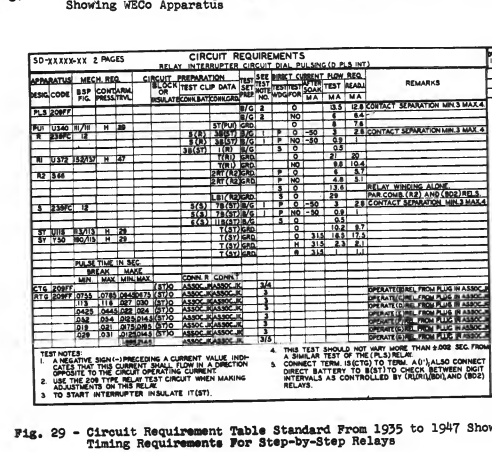
Fig. 28 - Universal Circuit Requirement Table Standard From 1935 to 1947 Showing WECo Apparatus



CIRCUIT REQUIREMENTS

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RELAY INTERRUPTER CIRCUIT, DIAL PULSING (D PLS INT.)

ISS 5

APPARATUS DESIG.	CODE	MECH. REQ. BSP FIG.	CONT. ARM PRESS.	TRVL.	RESID.	CIRCUIT PREPARATION BLOCK OR INSULATE	TEST CLIP DATA	TEST SET NOTE	TEST NO.	SEE DIRECT CURRENT FLOW REQ. TEST WDG/OHM	AFTER SOAK	TEST MA	READ MA	REMARKS
										B/G	2	O		13.5	12.8	CONTACT SEPARATION MIN 3 MAX 4
PLS 209FF										B/G	2	NO		6	6.4	
PUI	U340	III/III		H	.89		ST (PUI) GRD.					O		8	7.6	
R	239FC	12					R (R) 38 (ST)	B/G	1	P	O	-50	3	2.8	CONTACT SEPARATION MIN 3 MAX .4	
							R (R) 38 (ST)	B/G	1	P	NO	-50	0.9	1		
							38 (ST) (R)	B/G	1	S	O		0.5			
RI	U372	152/13		H	.47		T (R1) GRD.					O		21	20	
							T (R1) GRD.					NO		8.8	10.4	
R2	156						2RT (R2) GRD.			P	O			5	5.7	
							2RT (R2) GRD.			P	NO			4.8	5.1	
										S	O			13.6		RELAY WINDING ALONE.
							L BI (R2) GRD.			S	O			29		PAIR COMB. (R2) AND (BD2) REQ'S.
S	239FC	12				3 (S)	T8 (ST) B/G		1	P	O	-50	3	2.8	CONTACT SEPARATION MIN 3 MAX 4	
						8 (S)	T3 (ST) B/G		1	P	NO	-50	0.9	1		
						6 (S)	T11 (ST) B/G			S	O			0.5		
SY	U118	83/113		H	.29		T (SY) GRD.					O		10.2	9.7	
SY	T30	180/115		H	.29		T (SY) GRD.					O	315	16.3	17.3	
							T (SY) GRD.					H	315	2.3	2.1	
							T (SY) GRD.					R	315	1	1.1	

	PULSE TIME IN SEC. BREAK MIN.	MAKE MAX. MIN.	MAX.	CONN. R	CONN. T			
CTG 209FF				A (ST) O	A 5300C-IR	A 5300C-IR	3/4	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
RTG 209FF	.0755	.0785	.0845	.0873	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
	.1113	.1118	.1287	.1310	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
	.0429	.0443	.1283	.1324	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
	.042	.034	.1282	.1314	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
	.012	.021	.1279	.1293	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
	.029	.031	.1281	.1343	A (ST) O	A 5300C-IR	A 5300C-IR	3	OPERATE (S) REL. FROM PLUG IN A 5300C-IR
					A 5300C-IR	A 5300C-IR	A 5300C-IR	3/5	

TEST NOTES:

1. A NEGATIVE SIGN (-) PRECEDING A CURRENT VALUE INDICATES THAT THIS CURRENT SHALL FLOW IN A DIRECTION OPPOSITE TO THE CIRCUIT OPERATING CURRENT.
2. USE THE 209 TYPE RELAY TEST CIRCUIT WHEN MAKING ADJUSTMENTS ON THIS RELAY.
3. TO START INTERRUPTER INSULATE IT (ST).
4. THIS TEST SHOULD NOT VARY MORE THAN ±.002 SEC. FROM A SIMILAR TEST OF THE (PLS) RELAY.
5. CONNECT TERM. 13 (CTG) TO TERM. A (I), ALSO CONNECT DIRECT BATTERY TO B (ST) TO CHECK BETWEEN DIGIT INTERVALS AS CONTROLLED BY (RI, RII, BD) AND (BD2) RELAYS.

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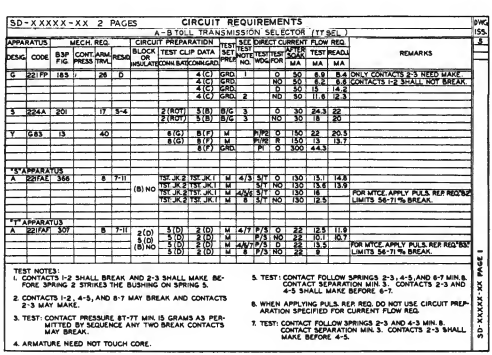
Fig. 29 - Circuit Requirement Table Standard From 1935 to 1947 Showing Timing Requirements For Step-by-Step Relays



SD-XXXXX-XX 2 PAGES — CIRCUIT REQUIREMENTS — A-BTOLL TRANSMISSION SELECTOR (TT SEL.) — 9 WG. 155

APPARATUS		MECH. REQ.				CIRCUIT PREPARATION			TEST	SEE DIRECT CURRENT FLOW REQ.				REMARKS
DESIG.	CODE	BSP FIG	CONT. SPRING PRESS	ARMA TRVL	RESID.	BLOCK OR INSULATION	TEST CLIP DATA COMM. BAR	CONN. BAR	SET PRIOR TO	WIRE NO.	TEST FOR	OPER. MA	TEST RELEASE MA	
G	221-PP	183		26	D			4 (C)	GRD.	1	O	50	6.9	8.4 ONLY CONTACTS 2-3 NEED MAKE.
								4 (C)	GRD.		NO	50	6.2	8.0 CONTACTS 1-2 SHALL NOT BREAK.
								4 (C)	GRD.		D	50	13	14.2
								4 (C)	GRD.	2	NO	50	11.8	12.3
S	224-A	201		17	3-4		2 (ROT)	5 (B)	B/C	3	O	30	24.3	22
							2 (ROT)	5 (B)	B/C	3	NO	30	18	20
Y	683	13		40			8 (G)	8 (F)	M		P/PE	O	150	22	20.5
							8 (G)	8 (F)	M		P/PE	R	150	13	13.7
								8 (F)	GRD.		PI	O	300	44.3	
S APPARATUS														
A	221-AE	366		8	7-11	(B) NO	1ST. JK 2	1ST. JK 1	M	4/3	S/T	O	130	15.1	14.8
							1ST. JK 2	1ST. JK 1	M		S/T	NO	130	15.8	13.9
							1ST. JK 2	1ST. JK 1	M	4/5	S/T	O	130	18	FOR MTCE. APPLY PULS. REP. REQ. & LIMITS 56-71% BREAK.
							1ST. JK 2	1ST. JK 1	M	8	S/T	NO	130	12.5	
T APPARATUS														
A	221-AF	307		8	7-11	2 (D)	5 (D)	2 (D)	M	4/7	P/S	O	22	12.5	11.9
						5 (D)	5 (D)	2 (D)	M		P/S	NO	22	10.1	10.7
						(B) NO	5 (D)	2 (D)	M	4/8	P/S	D	22	13.5	FOR MTCE. APPLY PULS. REP. REQ. & LIMITS 56-71% BREAK.
							5 (D)	2 (D)	M	8	P/S	NO	22	8	

TEST NOTES:
1. CONTACTS 1-2 SHALL BREAK AND 2-3 SHALL MAKE BEFORE SPRING 2 STRIKES THE BUSHING ON SPRING 5.
2. CONTACTS 1-2, 4-5, AND 8-7 MAY BREAK AND CONTACTS 2-3 MAY MAKE.
3. TEST: CONTACT PRESSURE 8T-7T MIN. IS GRAMS AS PERMITTED BY SEQUENCE ANY TWO BREAK CONTACTS MAY BREAK.
4. ARMATURE NEED NOT TOUCH CORE.
5. TEST: CONTACT FOLLOW SPRINGS 2-3, 4-5, AND 8-7 MIN. & CONTACT SEPARATION MIN. 5. CONTACTS 2-3 AND 4-5 SHALL MAKE BEFORE 6-7.
6. WHEN APPLYING PULS. REP. REQ. DO NOT USE CIRCUIT PREPARATION SPECIFIED FOR CURRENT FLOW REQ.
7. TEST: CONTACT FOLLOW SPRINGS 2-3 AND 4-3 MIN. & CONTACT SEPARATION MIN. 3. CONTACTS 2-3 SHALL MAKE BEFORE 4-5.

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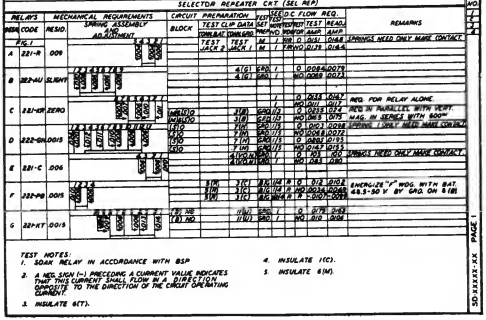
Fig. 30 - Circuit Requirement Table Standard From 1935 to 1947 Showing Both Step-by-Step and Other Relays



SD XXXXX-XX 3 PAGES — CIRCUIT REQUIREMENTS — SELECTOR REPEATER CKT. (SEL. REP.) — CKT. NO. 155

RELAYS	MECHANICAL REQUIREMENTS SPRING ASSEMBLY AND ADJUSTMENT			CIRCUIT PREPARATION			WIRE	NEED D.C. FLOW REQ.				REMARKS
DESIG.	CODE	RESID.		BLOCK	TEST CLIP DATA		SET PRIOR TO	WIRE NO.	TEST FOR	TEST RELEASE		
	FIG.				TEST	TEST	M			OPER. MA	AMP	SPRINGS NEED ONLY MAKE CONTACT.
A	221-R	.009										
B	222-AV	SLIGHT			4(G)	5(D)	/		O	.0008	.0007	
					4(G)	5(B)	/		NO	.0008	.0013	
C	222-GR	ZERO		W.NO.10	3(B)	5(D)	/		O	.0018	.0014	REQ. FOR RELAY ALONE.
				W.NO.10	3(B)	5(D)	/		NO	.0018	.0017	
D	222-GN	.001/5		1.510	7(H)	5(D)	/		O	.0013	.0018	REQ. IN PARALLEL WITH 1.509.
				1.510	7(H)	5(B)	/		NO	.0018	.0015	MAG. IN SERIES WITH .500" SPRING. ONLY NEED MAKE CONTACT.
				1.510	7(H)	5(B)	/		NO	.0018	.0017	
				1.510	7(H)	5(B)	/		NO	.0018	.0015	
E	221-C	.006		W.NO.10	4(G)	5(D)	/		O	.001	.001	SPRINGS NEED ONLY MAKE CONTACT.
				W.NO.10	4(G)	5(B)	/		NO	.001	.001	
F	222-PB	.001/5			5(M)	3(C)	W.NO.14	R	O	.012	.012	ENERGIZE "F" WDG. WITH BAT. 46.5-50 V. BY GAG ON 9 (M)
					5(M)	3(C)	W.NO.14	R	NO	.0034	.0028	
					5(M)	3(C)	W.NO.14	R	I	.0057	.0051	
G	222-KT	.001/5			(N) NO		(N)	5(B)	/	O	.078	.068
					(N) NO		(N)	5(B)	/	NO	.100	.0108

TEST NOTES:
1. SOAK RELAY IN ACCORDANCE WITH BSP.
2. A NEG. SIGN (-) PRECEDING A CURRENT VALUE INDICATES THAT THIS CURRENT SHALL FLOW IN A DIRECTION OPPOSITE TO THE DIRECTION OF THE CIRCUIT OPERATING CURRENT.
3. INSULATE 6(T).
4. INSULATE (TC).
5. INSULATE 6(M).

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Fig. 31 - Circuit Requirement Table Standard From 1925 to 1935 Covering Step-by-Step Relays

4.02 Division of Table: On circuit requirement tables issued from 1925 to 1935 covering step-by-step relays, the first main division heading was RELAYS instead of APPARATUS, as shown in Fig. 31. Prior to 1937 the column heading TIME REQ was not shown.

APPARATUS

DESIG

4.03 In the column with this heading is given the functional designation which is assigned to each relay. The circuit figures are covered on the CRT in numerical order. In some cases, however, the apparatus for the main (unnumbered and unlettered) figure is covered first followed by the apparatus for the lettered figures in numberical and then alphabetical order. Under each figure, the relay designations appear in numerical and then alphabetical order as far as possible. Where options are used on some drawings, the options appear in alphabetical order. On drawings issued after 1937, options are listed in reverse alphabetical order starting with Z, Y, X, etc.

4.04 If a relay of a given designation may be one of two or more different code numbers, the same designation is repeated opposite each code number but a separate subtitle such as "'S' Apparatus" or "'T' Apparatus" or "'S' Option" or "'T' Option" similar to that shown in Fig. 30 is shown above each separate code number. In some cases, the "'S' Apparatus" or "'T' Apparatus" notation appears in the REMARKS column.

4.05 On circuit requirement tables, issued prior to 1937, an asterisk was placed adjacent to the designations where two different relays had the same letter designation, and the SEE TEST NOTE NO. column referred to a test note which gave the following information: "*Indicates that there is more than one relay with the same designation."

MECH REQ

4.06 On tables standard from 1925 to 1935 covering step-by-step relays, this division of the table was subdivided into two columns, one headed RESID (3.13, 4.11, and 4.12) and one headed SPRING ASSEMBLY AND ADJUSTMENT (4.10).

BSP FIG.

4.07 Same as 3.15 to 3.18, inclusive, except that this column was formerly headed BSMP FIG. It was formerly the practice to specify only one spring combination number where the spring combinations on a relay were the same.

CONT PRESS.

4.08 Same as 3.19 except that the letters H and L for high- and low-contact pressure, respectively, replace the numbers 20 and 10 which were formerly used to indicate the normal contact pressure for a relay.

ARM. TRVL

4.09 Same as 3.20 except that on step-by-step type relays, circuit requirement tables issued prior to 1936 expressed the armature travel in inches.

SPRING ASSEMBLY AND ADJUSTMENT

4.10 A column so headed was shown prior to 1935 on circuit requirement tables covering step-by-step relays. A schematic arrangement of the relay spring combination was shown in this column as illustrated in Fig. 31. The number of the spring is indicated at the top of each spring assembly between the various make and break combinations of springs. The spring adjusting requirements are shown in decimal parts of an inch. The armature travel (also called "stroke") of the relay, when specified, is shown in decimal parts of an inch to the right or left of the number 1 spring, depending respectively on whether the relay is a left- or right-hand mounted relay.

LOC or RESID

4.11 One of these headings may be specified on the circuit requirement table. This column, which immediately followed the column heading ARM. TRVL may also be blank. When the column is headed RESID, it is part of MECH REQ. When the column is headed LOC, it is listed separately. This information in other respects is the same as that covered in 3.12 and 3.13.

4.12 The column heading LOC was not used prior to 1935. Prior to 1935, the heading RESID was used on circuits showing AECo apparatus.

CIRCUIT PREPARATION

BLOCK OR INSULATE

4.13 Same as 3.22 to 3.24 except that this column was formerly headed BLOCK.

TEST SET PREP.

4.14 Same as 3.27 to 3.43, except that the designation G was formerly used for designating ground and BAT/V for battery voltage applications.

SEE TEST NOTE NO.

4.15 Same as 3.44 except that on circuit requirement tables issued prior to 1936, the values for mechanical requirements were expressed in inches.

DIRECT CURRENT FLOW REQ (DC FLOW REQ)

4.16 The information covered in this column is the same as that described in 3.45 except that, where a negative (-) sign precedes a current flow requirement, an explanation is given in a test note or under the REMARKS column as follows: "A negative sign (-) preceding a current flow indicates that this current shall flow in a direction opposite to the direction of the circuit operating current."

Example: (-45) would indicate that 45 milliamperes should be passed through the winding of the apparatus in a direction opposite to the direction of the normal circuit operating current for the apparatus.

TEST WDG

4.17 Same as 3.46 except that on CRTs, the designation I for inner was used to show the primary winding and the letter O for outer was used to show the secondary winding.

TEST FOR, AFTER SOAK, TEST MA, READJ MA.

4.18 Same as 3.48 to 3.51 except that on CRTs issued prior to 1936, the electrical requirements in the columns headed AFTER SOAK, TEST, and READJ were expressed in amperes instead of milliamperes.

TIME REQ

4.19 Same as 3.52 to 3.54 except that prior to 1937, the column heading TIME REQ was not shown.

OPTIONS

4.20 If options are shown on ES and SD drawings, the CRT is divided into two or more parts showing a complete list of apparatus for each option in a separate group. There is a space of two lines between options of the CRT and the name of the option is on one of these lines. The apparatus associated with any option is located immediately below the name of the option.

REMARKS

4.21 Same as in 3.52 and 3.53.

Tables Where Pulse Speed and Per Cent Break Are Specified

4.22 This information is similar to that described in 3.72 to 3.75 except that it is located under the heading MECH REQ instead of APPARATUS.

5. CIRCUIT REQUIREMENT TABLES ISSUED PRIOR TO 1925

5.01 Examples of the CRTs issued prior to 1925 are shown in Figs. 32 and 33. The tables covering step-by-step apparatus were formerly known as WR sheets.

5.02 These tables are the same as those covered in Part 4 except for the items covered below.

5.03 See Test Note 1: If the circuit requires certain preliminary preparation before applying the circuit requirements, a reference to TEST NOTE 1 is shown in the upper left-hand corner of the circuit requirements space for the purpose of calling attention to TEST NOTE 1. This test note contains the information necessary for the circuit's preliminary preparation. The test notes are shown immediately below the requirements for the relays.

5.04 Transmission Requirements: On some CRTs, the first space above the apparatus space is blank, except for a few cases where the notation "No Transmission Requirement" has been entered. If a circuit is reissued to specify transmission requirements, these are given in a circuit note.

5.05 Apparatus - See Spec: All apparatus such as selectors, connectors, line switches, keys, jacks, and interrupters specified in the circuit, other than specific relays are listed in this space together with the number of the X- specification which covered its installation and maintenance requirements. In addition to the above, the X- specifications which covered the general mechanical requirements for the three types of step-by-step relays; namely, the pivot, horizontal, and dash pot types, were listed in this space, such as pivot-type relays, X-70105. This information has been superseded by the apparatus requirement and adjusting procedure sections dealing with the specific type of apparatus.

CIRCUIT REQUIREMENT TABLE COVERING WESTERN ELECTRIC APPARATUS (EXCLUSIVE OF 221, 222, 223, 224, 225, 247, 248, 251, 252, AND SIMILAR AECO RELAYS

5.06 Division of Table: Immediately below the spaces provided for APPARATUS, the requirements for the relays, drops, signals, and message registers are given. The table is divided into seven main divisions which are further subdivided as follows.

Column Headings	Described in
RELAYS	5.07,5.09
CODE	5.08
DESIG	5.09
MECHANICAL REQ	5.10-5.12
SPEC NUMBER	5.10
FIG. OR SK	3.14-3.17
CONT PRESS.	5.11
ARM. TRVL	5.12
DIRECT CURRENT FLOW REQ	3.45-3.51,4.16-4.18
TEST WDG NO.	5.20
TEST FOR	4.18
AFTER SOAK (AMPS)	4.18
TEST (AMPS)	4.18
READJ (AMPS)	4.18

Column Headings	Described in
CIRCUIT PREPARATION	3.20-3.26,5.13
SEQ SW POS	3.14
BLOCK	5.13
TEST CLIP DATA	3.25,3.26
CONN. BAT.	3.25
CONN. GRD	3.25
TEST SET PREP	4.14
SEE TEST NOTE NO.	4.15,5.03
REMARKS	3.52,3.53

CIRCUIT REQUIREMENTS

SEE TEST NOTE 1

SEE SPECIFICATION ~~2-70037~~ FOR EXPLANATION OF THIS FORM

APPARATUS	SEE SPEC
AIMH KEY	~~2-70156~~
AIMC KEY	~~2-70156~~

APPARATUS	SEE SPEC

APPARATUS	SEE SPEC

APPARATUS	SEE SPEC

RELAYS		MECHANICAL REQ					DIRECT CURRENT FLOW REQ			CIRCUIT PREPARATION				TEST SET PREP	SEE TEST NOTE NO.	REMARKS
CODE	DESIG	SPEC NUMBER	FIG OR SK	CONT PRESS	ARM TRVL	TEST FOR	AFTER SOAK AMPS	TEST AMPS	READJ AMPS	SEQ SW POS	BLOCK	TEST CLIP DATA CONN	BAT	GRD				
162-AK	(TR)	~~2-70067~~	H				0	.031	.029									
							R	O.C.	O.C.									
E201	(LU)	~~2-70037~~	3	H	020		0	.105	.055			RU(SL)	G		4			RATED EXT. SLEEVE RES. 34Ω
				L	020		0	.040	.038			RU(SL)	G		4/5			RATED EXT. SLEEVE RES 350Ω
E584	(LU)	~~2-70037~~	7/10	H	020		0	.033	.020			RU(SL)		BAT	4			RATED EXT. SLEEVE RES. 220Ω
E600	(CT)	~~2-70037~~	8/3	H	020		0	.018	.017			RU(CT)	G					
E945	(FR)	~~2-70037~~	8	H	020		0	.034	.038			RU(FR)	G					
E698	(A)	~~2-70037~~	4/2	H	015		0	.085	.077			RU(A)	G					
							NO	.049	.052			RU(A)	G					
636	(S)	~~2-70056~~	7			P/S	O	.073	.0072	.0068		ST(CT)	1B(CT)	M		2/3		MAX EXT CKT LOOP 2600Ω MIN. LEAK RES 10000Ω
							R	.073	.0028	.003		ST(CT)	1B(CT)	M				
R209	(SH)	~~2-70037~~	7/10	H		020 P/S	O		.030	.016		LU(SL)		BAT	4			RATED EXT. SLEEVE RES. 220Ω
						P/S	H		.021	.0139		LU(SL)		BAT	4			RATED EXT. SLEEVE RES. 220Ω
R972	(LU)		3	L	020		0		.019	.018		RU(SL)	G		4			RATED EXT. SLEEVE RES. 350Ω

TEST NOTES

1. BEFORE MAKING ANY TESTS OR ADJUSTMENTS A TROUBLE CAP MUST BE PLACED ON THE SLEEVE OF THE CORD
2. SPECIAL REQUIREMENTS TO INSURE CONTACT PRESSURE.
3. THIS IS MAXIMUM CAPABILITY FOR PARTICULAR FUNCTION.
4. % INDICATES MORE THAN ONE RELAY HAVING THE SAME DESIGNATION.
5. SPECIAL REQUIREMENTS TO MEET CIRCUIT CONDITION. THIS ADJUSTMENT TO BE USED ONLY AT WESTCHESTER OFFICE, N.Y.

Fig. 32 - Circuit Requirement Table Issued Prior to January, 1925, Covering WECo Apparatus (Excluding Step by Step Type)

RELAYS

5.07 On some of the CRT under the old style form the CODE and DESIG columns are reversed and the relays are listed alphabetically instead of numerically.

CODE

5.08 In this column, the code number of the apparatus is listed.

DESIG

5.09 In this column, the designation of the apparatus is listed.

MECHANICAL REQ

SPEC NUMBER

5.10 In this column is given the number of the X- specification which contained the general mechanical requirements for the particular type of relay involved. For example, E-, H-, and R-type relays refer to X-70037, B and G type to X-70056, 114 type to X-70054, etc. The numbers given in this column have been crossed out since the X- specifications have been replaced by apparatus requirement and adjusting procedure sections.

CONT PRESS.

5.11 This column is only used in connection with specifying contact pressure requirements for E-, H-, and R-type relays. The notations 10, 20, and SPL are shown in this column to designate the contact pressure of a relay. The numerals 10 and 20 indicate which particular set of tensions associated with a particular figure or figures in the section should be used. The designation SPL indicates that the contact pressure is special and as such is covered by a test note, referred to in the SEE TEST NOTE column. If the circuit is reissued and an E-, F-, H-, R-, or T-type relay is added, the contact pressure is specified in this column by the letters H, L, or SPL. H and L, respectively, replace the numerals 20 and 10.

ARM. TRVL

5.12 The rated armature travel for the relay is indicated in this column for E-, H-, and R-type relays, expressed in decimal parts of an inch. If the circuit is reissued and a B-, G-, F-, or T-type relay is added, the armature travel is specified in this column. For the F- and T-type relays, the rated value is specified and for B- and G-type relays, the maximum value is specified. Those relays that have special armature travel requirements are indicated by the notation SPL in this column and such special requirements are given in a test note, which is referred to in the SEE TEST NOTE column or in the REMARKS column.

CIRCUIT PREPARATION

BLOCK

5.13 The information in this column is the same as that covered in 3.22 to 3.24 except that if the relay has no letter designation, the code number of the relay is given. For example, the information under BLOCK may be RL (E6175). Similarly under CONN BAT. and CONN GRD, the following may be given as LU (E676), LL (E1025).

CIRCUIT REQUIREMENT TABLE COVERING 221, 222, 223, 224, 247, 248, 251, 252, AND SIMILAR AECO RELAYS

5.14 Division of Table: Immediately below the spaces provided for APPARATUS the requirements are given for relays, drops, signals, and message registers. The table is divided into seven main divisions which are further subdivided as follows.

Column Headings	Described in
RELAYS	5.15-5.19
CODE NO.	5.16
COIL NO.	5.17
DESIG	5.18
STYLE OF CORE	5.19
MECHANICAL REQ	3.14-3.19
RESID	3.11,3.13
SPRING ASSEMBLY AND ADJUSTMENT	4.10
DIRECT CURRENT FLOW REQ	5.20,5.21
TEST WDG NO.	5.20
WDG RES	5.21
TEST FOR	4.18
TEST (AMP)	3.51,4.18
READJ (AMP)	3.51,4.18
CIRCUIT PREPARATION	3.21-3.26,5.13
BLOCK	5.13
TEST CLIP DATA	3.25,3.26
CONN.BAT.	3.25
CONN.GRD	3.25
TEST SET PREP.	3.27-3.43,4.14
SEE TEST NOTE 1	3.44,5.03
REMARKS	3.53

RELAYS

5.15 The columns under this heading include identifying information for the relay for which requirements are specified.

CODE NO.

5.16 In the column with this heading are given the code numbers of the various relays.

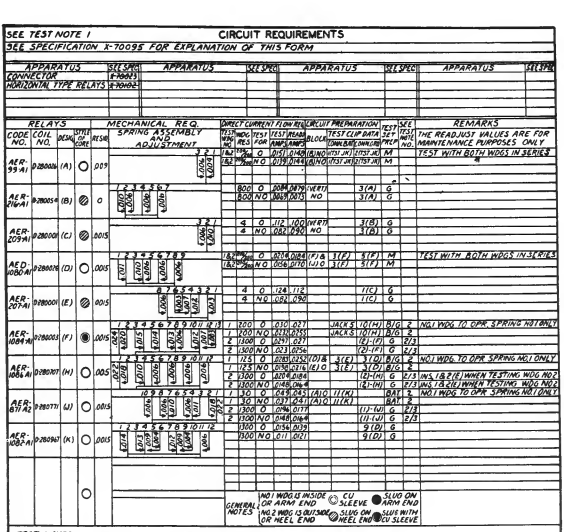


Fig. 33 - Circuit Requirement Table Issued Prior to January, 1925, Covering Step-by-Step Type Relays

COIL NO.

5.17 In the column with this heading are given the coil numbers of the various relays.

DESIG.

5.18 In this column the letter designation of the relay is listed.

STYLE OF CORE

5.19 The style of the relay core is indicated in the circles shown in this column. A plain circle indicates an ordinary iron core. An interpretation of the four possible markings of a circle to indicate special cores is given in the GENERAL NOTES at the bottom of the relay requirements space.

DIRECT CURRENT FLOW REQ

TEST WDG NO.

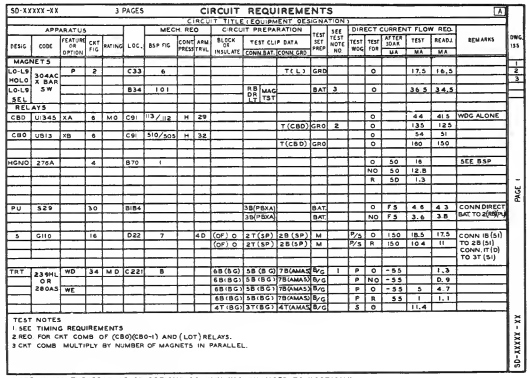
5.20 In this column is given the number of the relay winding designation. An explanation of these numbers is given in the GENERAL NOTES at the bottom of the relay requirements space.

WDG RES

5.21 In this column is given the resistance of the relay windings.

REASONS FOR REISSUE

1. To add a paragraph covering the detached-contact circuit drawing CRT (1.05).
2. To revise the index of circuit requirement table headings (1.07).
3. To revise the paragraph covering size of pages (2.01).
4. To revise the paragraph covering page numbering (2.02).
5. To revise the paragraph covering the CRT title (2.03).
6. To revise the paragraph covering the issue number of CRT (2.04).
7. To revise the table showing types of CRT (3.01).
8. To delete the reference to detached information on timing requirements and step-by-step relays (3.03).
9. To revise the division of CRT table (3.04).
10. To delete the reference to the same designation appearing for different apparatus (3.06).
11. To revise the paragraph covering option (3.08).
12. To revise the paragraph covering CKT FIG. and FIG. (3.09).
13. To revise the paragraph covering rating (3.10).
14. To revise the paragraph covering LOC, RESID, or SEQ SW POS (3.11).
15. To revise the paragraph covering BSP FIG. (3.15).
16. To add AF-, AG-, and AJ-type wire-spring relays and a U-type relay spring combination to Table A.
17. To amplify the meaning of the designation SPL (3.19).
18. To delete the information covering blocking apparatus and circuit preparation (3.24).
19. To revise Table B.
20. To delete the note in 3.32 of previous issue.
21. To amplify paragraph covering TEST SET PREP. to specify test set connection lead (3.32 to 3.39).
22. To add a note to the paragraph covering B/G (Battery and Ground) (3.36).
23. To add a note to the paragraph covering +B/G (Position Battery to Ground)(3.37).
24. To revise the paragraph covering NGB (Nongrounded Battery) 3.38(a)].
25. To delete 3.38(b), (c), (e), (f), and (g) of previous issue.
26. To add a note to the paragraph covering SEE TEST NOTE NO. (3.44).
27. To amplify the explanation of test windings (3.47).
28. To revise the paragraphs on AFTER SOAK (3.49 and 3.50).
29. To delete 3.51 of previous issue of section.
30. To revise the paragraphs on REMARKS AND TIME REQ (3.52, 3.53, and 3.54).
31. To revise the division of the Timing Requirement Table (3.60).
32. To revise the paragraph covering DESIG (3.61).
33. To add a note to the paragraph covering TEST FOR (3.67).
34. To delete the references to RAP Fig. (4.07).
35. To revise Figs. 1, 3, 10, 11, 20, 34, and 36.
36. To add Figs. 35 and 37.



50-XXXXX-XX	3 PAGES	CIRCUIT REQUIREMENTS (CIRCUIT TITLE/EQUIPMENT DESIGNATION)																											A
APPARATUS							MECH REQ			CIRCUIT PREPARATION							TEST SET PREP	SEE TEST NOTE NO.	DIRECT CURRENT FLOW REQ.									DWG. 155
DESIG.	CODE	FEATURE OR OPTION	CKT FIG.	RATING	LOC.	BSP FIG.	CONT PRESS/TRVL	ARM PRESS/TRVL	BLOCK OR INSULATE	TEST CLIP DATA									TEST WDG	TEST FOR	AFTER SOAK		TEST		READJ		REMARKS	
										CONN BAT	CONN GRD										MA		MA		MA			
MAGNETS																													1
LO-LO HOLD	304AC X BAR SW	P	2		C33	6					T(LT)	GRD								O			17.5		16.5			2
LO-LO SEL					B34	101				RB DC AT	MAG TST			BAT	3					O			38.3		34.5			3
RELAYS																													
CB0	U345	XA	8	MO	C91	113/112	H	29												O			44		41.5		WDG ALONE	
CB0	US13	XB	8		C91	510/505	H	32			T(CBD)	GRD		2						O			135		125			
																				O			54		51			
											T(CBD)	GRD								O			190		150			
HGNO	278A		4		B70	1														O	50		16				SEE BSP	
																				NO	50		12.8					
																				R	50		1.3					
PU	529		30		B184					3B(PBXA)				BAT						O	F5		4.6		4.3		CONN DIRECT BAT TO ASSEMBLY	
										3B(PBXA)				BAT						NO	F5		3.6		3.8			
5	G110		16		D22	7		40	(OF) G	2T(SP)	2B(SP)		M			P/S	O	150		185		17.5		CONN 1B(5A) TO 2B(5A)	
									(OF) G	2T(SP)	2B(SP)		M			P/S	R	150		104		11		CONN 1T(G) TO 3T(5A)	
TFT	239AL OR 280AS	WD	34	MO	C221	8				6B(BG)	5B(BG)	7B(AMA)	B/G		1	P	O	-55					1.3					
										6B(BG)	5B(BG)	7B(AMA)	B/G			P	NO	-55					D.9					
		WE								6B(BG)	5B(BG)	7B(AMA)	B/G			P	O	-55		5			4.7					
										6B(BG)	5B(BG)	7B(AMA)	B/G			P	R	55		1			1.1					
										4T(BG)	3T(BG)	4T(AMA)	B/G			S	O			11.4								

TEST NOTES
1 SEE TIMING REQUIREMENTS
2 REQ. FOR CKT COMB. OF (CB0)(CB0-1) AND (LOT) RELAYS.
3 CKT COMB. MULTIPLY BY NUMBER OF MAGNETS IN PARALLEL.

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NOTE. IN 1951 THE "FEATURE OR OPTION" COLUMN WAS CHANGED TO "OPTION" AND THE COLUMN HEADING "RATING" WAS DELETED.

Fig. 34 - Universal Circuit Requirement Table Standardized in 1947 for Attached-contact Circuit Drawings

CIRCUIT REQUIREMENTS — DWG 155

APPARATUS				MECH REQT			CIRCUIT PREPARATION				TEST SET PREP	SEE NOTE	DIRECT CURRENT FLOW REQT						REMARKS
OESIG	CODE	OPTION	FIG.	BSP FIG.	CONT PRESS.	ARM. TRVL	BLOCK OR INSULATE	TEST CLIP DATA					TEST WDG	TEST FOR	AFTER SOAK		TEST	READJ	
								CONN BAT.	CONN GRD						MA.		MA.	MA.	
TOL	AF63		9	229			(RA) 0		U(TOL)		GRD.			0		7.1	6.7		
TFQ.1 2,4,7	AF51		5	3				U	REL. TST		GRD.			0		20.5	19.5		
TFT	AJ12		9	220					U(TFT)		GRD.			0		43	40.5		
TM	AF80		4	12				U(TM)			45V			0		6.6	6.2	SEE TIMING REQ. PAGE 6	
TMA	AF70		4	202			(TMB) 0		1U(TMA)		GRD.		P	0		17.5	16.5		
							4(TMA)		2U(TMA)		GRD.		S	0		10.9			
TMB	AF85		4	401					U(TMB)		GRD.			0		36	34		
														R		8.9	10.5		
TOL	AF24		7	6					U(TOL)		GRD.			0		30.5	29		
TRL	AF48		1	26					U(TRL)		GRD.			0		85	90		

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Fig. 35 - Circuit Requirement Table Standardized in 1953 for Detached-contact Circuit Drawings

TIMING REQUIREMENTS (A) — DWG 155

APPARATUS DESIG	APPARATUS CODE	APPARATUS FEATURE OR OPTION	APPARATUS CAT FIG.	APPARATUS RATING	CIRCUIT PREPARATION BLOCK OR INSULATE	CIRCUIT PREPARATION TEST CLIP DATA CONN BK	CONN R	CONN W	TEST SET PREP SEND KEY	REC SW START	REC SW STOP	SEE TEST NOTE NO.	TEST FOR	TIME REQ MIL-SEC MIN	TIME REQ MIL-SEC MAX	REMARKS
A25	UB6000		29			GRD.	11T(A25)	7T(A25)	MK	G.G.	GRD.	1	O		8.8	
						GRD.	11T(A25)	7T(A25)	BK	GRD.	GG.	1	R		5.5	
FTI	UB6005		28			GRD.	7T(FTI)	4T(FTI)	MK	GG.	48V.	1	O		8.8	
						GRD.	7T(FTI)	4T(FTI)	BK	48V.	O.G.	1	R		6.2	
RSR	Y188		31		(AL)NO (MON)O	GRD.	5B(RSR)	1T(RSR)	MK	GRD.	O.G.		R	120	310	GRD 2T (RSR)
TIE	UB6000		27			GRD.	11T(TIE)	9T(TIE)	MK	48V.	GRD.		O		8.8	
						GRD.	11T(TIE)	9T(TIE)	BK	GRD	48V		R		5.5	
TRTR	U1047		79			GRD.	T(TRT)	8T(TRTR)	MK	GRD	O.G.		O	2000	3150	
TYM	280A		77		(PBX2)O (TLC2) O	4T(AK)	2B(HTUK)	2B(PBX2)	BK	O.G	GRD.		O	20	23	

TEST NOTES:
1. SET READER DIAL AT O.

NOTE:-IN 1951 THE "FEATURE OR OPTION" COLUMN WAS CHANGED TO "OPTION" AND THE COLUMN HEADING "RATING" WAS DELETED.

Fig. 36 - Standard Timing Requirement Table for Attached-contact Circuit Drawings

TIMING REQUIREMENTS — DWG 155

APPARATUS DESIG	APPARATUS FEATURE OR OPTION	FIG.	CIRCUIT PREPARATION BLOCK OR INSULATE	TEST CLIP DATA CONN BK	CONN R	CONN W	TEST SET PREP SEND KEY	REC SW START	REC SW STOP	SEE NOTE	TIME REQ MIL-SEC MIN	TIME REQ MIL-SEC MAX	REMARK
ATM		1	(BD) O	GRD	U(ATC)	7(ATM)	MK	-48	OC		660	1000	
			(BD) O (CL2)O	GRD	U(ATC)	7(ATM)	MK	-48	OC		350	550	
			(BD) O (TTK)O	GRD	U(ATC)	7(ATM)	MK	-48	OC		2000	3100	
			(BD) O (TTK)O (ATC)O	GRD	U(ATC)	7(ATM)	MK	-48	OC		4600	7200	
TM		1	(STT)O								20800	31000	OPERATE ONI RELAY TO START TIMER MEASURE TIME UNTIL TM OPERATES.
											7200	10800	

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Fig. 37 - Standard Timing Requirement Table for Detached-contact Circuit Drawings